SIDS INITIAL ASSESSMENT PROFILE

CAS NO	123-38-6
CHEMICAL NAME	Propanal
STRUCTURAL FORMULA	O CH3-CH2-CH

RECOMMENDATION OF THE SPONSOR COUNTRY

[**X**] currently of low priority for further work
[ ] currently of low priority for further work, but avoid exposure to man and the environment
[ ] requiring further information to assess identified concerns
[ ] candidate for in-depth risk assessment with a view to possible risk reduction activities

SHORT SUMMARY OF THE REASONS WHICH SUPPORT THE RECOMMENDATION

Although propionaldehyde is a high production volume chemical, it finds use almost solely as a chemical intermediate. The aldehyde itself does not have uses in consumer products. Production and conversion to other chemicals necessarily take place in closed systems because of the extremely volatile nature of this chemical. The material is transported between site locations by bulk carrier. These practices minimize exposure within the workplace. This assumption is supported by industrial hygiene monitoring data which indicate a large portion of samples are below the detection limit of 0.01 ppm and exposures very rarely exceed 1 ppm.

U.S. TRI reporting requirements indicate that sizable fugitive emissions exist. However, propionaldehyde has a relatively short existence in air ($T_{1/2} \approx 6$ hours). In addition, the chemical will tend to partition from air into water (Henry's Constant 3.32 atms./mole fraction). Aldehydes are reactive and readily oxidize, propionaldehyde yielding propionic acid, a natural constituent in nature. Further, if the aldehyde were to enter the systemic milieu of an organism, it would be rapidly oxidized to propionic acid and serve as a nutrient.

Basic toxicology studies provide data to sufficiently identify the most sensitive toxic effect of propionaldehyde, irritation upon direct contact with tissues. It does not have specific adverse effects on the reproductive capabilities of either male or female rats and does not produce specific adverse effects on the developing offspring of laboratory animals. This aldehyde has exhibited weak genotoxic activity in some *in vitro* assay systems, this is consistent with what has been observed with other short-chain alkyl aldehydes.

These considerations, taken in total, demonstrate a low order of priority for further work.

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1.0 Exposure Assessment

1.1 Production Volumes:

The estimated annual production of propionaldehyde in the United States is in the order of 275 million pounds. Worldwide, it is estimated that 405 million pounds of this aldehyde are produced annually. Of this total production volume, it is believed that greater than 99% is used as an internal plant chemical intermediate.

1.2 Major Uses:

The major uses of propionaldehyde is as a reactive intermediate in the manufacture of n-propanol, propionic acid, 2-methyl pentanol, trimethyolethane polyols, polyethylene additives, fragrance chemicals and fungicides. Propionaldehyde, being a reactive chemical intermediate, is not directly used in products reaching the consumer. Because of its reactive nature and volatility, residual concentration of propionaldehyde in consumer products is very low.

1.3 Manufacturing Process:

Typically, propionaldehyde is manufactured by the catalytic hydroformylation of ethylene with carbon monoxide and hydrogen (Oxo Process). The reaction is carried out under high pressure in closed systems. Crude propionaldehyde is stripped of dissolved gasses and heavy residuals by gas stripping in pressured columns and stored for downstream derivatives production. Propionaldehyde is stored in pressured tanks or tanks equipped with internal floating roofs in order to minimize losses by evaporation. Processes which use propionaldehyde as a reactive intermediate are conducted in closed manufacturing systems.

1.4 Distribution:

For internal plant uses, propionaldehyde typically is transported by pipeline. Tank cars (rail cars) and tank trucks are used for shipment to domestic customers. I

1.5 Fugitive Emissions:

In the United States, for the year 1990, there were 18 facilities which reported environmental release information under provisions of the Super Fund Amendment Reauthorization Act (SARA). These were facilities either which manufactured or processed 25,000 pounds or more, or used more than 10,000 pounds of propionaldehyde. The Toxic Release Inventory (TRI) indicates that these facilities collectively released 988,986 pounds of propionaldehyde into the air and 34,885 pounds to other segments of the environment. By 1992, total TRI reported emissions had decreased by ≈25% from those reported in 1990.

1.6 Workplace Monitoring:

In the 17 year period between 1975 and 1992, a total of 73 personnel samples had been taken within the "Oxo" production unit of Union Carbide. Of these, 62 (»85%) were below the detection limit of 0.01 ppm. The maximum TWA measured over this interval was 26 ppm and the geometric mean for all 73 TWA determinations was »0.2 ppm. In the same time frame 16 TWA determinations were made within the In-Plant Distribution Department. Of these 8 (50%) were below the detection limit of 0.01 ppm. In one or two instances excursions in the range of 100 ppm were determined, but the geometric mean for all 16 samples was still in the range of 1 ppm. We believe that these low personnel exposures are typical of the industry as a whole. Considering the low concentrations of propionaldehyde measured within the production unit, air concentrations at the fence-line and within the surrounding community must be extremely low.

2.0 Summary of Environmental Effects

2.1 Environmental Fate:

Based upon the physical and chemical properties, propionaldehyde will not be a persistent environmental contaminant. This chemical is highly soluble in water and has an octanol/water partition coefficient of less than 1. As with most aldehydes, it is a reactive molecule and readily oxidizes to propionic acid. Propionic acid can be metabolized in biological organisms by the enzymatic pathways of intermediary metabolism: Thus, propionic acid serves as a nutrient. The aerobic Biological Oxidation Demand (BOD) has been shown to be 70% of the theoretical Chemical Oxidation Demand (COD) in 5 days and 95% in 20 days using unacclimated domestic sewage microorganisms. Given these considerations, propionaldehyde does not pose the threat of persistent environmental contamination.

2.2 Toxicity to Aquatic Organisms:

Propionaldehyde is of a moderate degree of toxicity to fish, is of a low order of toxicity to *Daphnia* and is moderately toxic to algae. These data suggest that it would pose a moderate environmental threat in the event of accidental spills into ponds or streams. Finally, the aldehyde has been shown to be at most only a slight threat to water treatment plants based on toxicity to bacteria.

2.3 Toxicity to Plants:

A single study demonstrated that propionaldehyde can inhibit the germination of seeds, but only at relatively high concentrations.

3.0 Summary of Health Effects:

3.1 Acute Toxicity and Primary Irritancy:

Propionaldehyde is of a moderate degree of lethal toxicity by single dose oral ingestion, only of slight acute lethal toxicity by a single exposure to vapor, is of slight lethal toxicity by skin contact but is moderately to severely irritating to the skin and could produce corneal damage if accidentally splashed into the eyes.

3.2 Effects Resulting from Repeated Exposure:

The major effect noted on repeated exposure to high concentrations of propionaldehyde in a study conducted under the OECD/SIDS Combined Protocol appeared to be associated with tissues which come in direct contact with the vapor, particularly the tissues of the nasal septum. In addition to the nasal lesions, evidence of hematological changes in male rats, predominantly associated with erythrocytes, and a slight effect on male relative kidney weight was noted at the 1500 ppm exposure concentration without histopathological confirmation of tissue damage. Decreased food consumption was noted in females exposed to vapor concentrations of 750 and 1500 ppm. No "No Observable Adverse Effects Level" (NOAEL) was established in this study, the NOAEL for systemic toxicity, however, was 150 ppm.

3.3 Effects on Reproductive Capabilities:

The effect of propionaldehyde on reproductive performance of rats was investigated in the OECD/SIDS Combined Protocol. In that study, no effects were noted on any reproductive parameter in animals exposed to vapor at concentrations up to 1500 ppm. Litter size and viability were similar among exposure groups (150, 750 and 1500 ppm) and the control. Thus the NOAEL for reproductive toxicity was greater than 1500 ppm.

3.4 Effects on Developmental Toxicity:

Information on the effects of propionaldehyde on the developing embryo and fetus was obtained in a study conducted by the OECD/SIDS Combined Protocol. In that study there was no evidence of external malformations in pups from dams exposed to vapor at concentrations up to 1500 ppm over the entire gestation. The data from the combined SIDS Protocol study suggest a NOAEL for developmental toxicity of greater than 1500 ppm.

3.5 Genotoxic Effects:

The genotoxic activity of propionaldehyde has been investigated in a number of different model systems. In a bacterial gene mutation assay using *Salmonella typhinurium* (Ames Test),

propionaldehyde consistently did not produce effects consistent with mutagenic activity. It did produce evidence of a weak mutagenic effect in an *in vitro* mammalian cell assay, the CHO V79 model No clastogenic activity was detected when propionaldehyde was tested in an *in vivo* mouse bone marrow micronucleus assay. These data are not inconsistent with those obtained with other short chain alkyl aldehydes such as formaldehyde and acetaldehyde.

4.0 Conclusions

Propionaldehyde is a high production volume chemical which finds almost sole use as a chemical intermediate. It use is primarily in the manufacture of n-propanol, propionic acid, 2-methyl pentanol, trimethyolethane polyols, polyethylene additives, fragrance chemicals and fungicides. It is produced and used exclusively in closed systems and transported by bulk carrier. These conditions predicate low exposure of personnel in the work place. This has been confirmed by industrial hygiene monitoring data. Considering the very low concentrations of propionaldehyde measured within production facilities, fence line concentrations need be negligible.

Based upon physical and chemical properties, propionaldehyde is an unlikely candidate as a persistent environmental contaminant. It is calculated to have a short half-life in air and would be scavenged from air into water. It is easily oxidized to propionic acid, a natural constituent of nature. The aldehyde itself has been shown to be moderately toxic to fish and algae and of a low order of toxicity to daphnia. Episodic accidental spills into ponds and streams would pose a moderate environmental threat. Considering its rapid oxidation to propionic acid, this threat would be temporary in nature.

Data is available to sufficiently identify the most sensitive toxic effect of propionaldehyde, irritation upon direct contact with tissue, particularly irritation of mucosa of the upper respiratory tract upon exposure to vapor. This observation is consistent with the known irritant effects of other short chain alkyl aldehydes including formaldehyde, acetaldehyde and butyraldehyde. Data generated in the OECD/SIDS Combined Protocol clearly demonstrate that propionaldehyde does not have specific adverse effects on the reproductive capabilities of either male or female rats. Data generated by this protocol and data from other studies which have been published in the open literature also clearly demonstrate that propionaldehyde does not produce specific adverse effects on the developing offspring of laboratory animals.

Considering all of the above, propionaldehyde would be of a low priority for further investigations.